INSTITUTE OF PAPER SCIENCE AND TECHNOLOGY

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INTERACTIONS BETWEEN STICKIES AND FIBER

Project F009-02

Report 1

A Progress Report

to the

MEMBER COMPANIES OF THE INSTITUTE OF PAPER SCIENCE AND TECHNOLOGY

By

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Introduction

The presence of stickies in recycled fiber can cause runnability problems, lead to hole and spot formation, and to decreased lifetime of felts. Industry attention has been focused on practical aspects of stickie prevention and removal, e.g., through more frequent pulper cleaning, and optimization of screens and slots, and centricleaner efficiency (1). The approach described here is longer term and more fundamental in nature. It seeks to understand the chemistry of the interaction between pulp, water, stickie and surfactants using polyvinyl acetate (PVAC) as a model, and to then apply the principles developed toward the control of stickies.

This initial report provides a literature survey of the nature and behavior of stickies. Furthermore, it overviews the procedures developed for an experimental study at IPST, and presents and discusses our preliminary results. A comprehensive report will follow in the first quarter of 1995.

Experimental Approach

Furnish Preparation

Wet Pulp

In order to compare results among different experiments it was necessary to use a constant quantity of fiber. For wet never dried unbleached kraft, we accomplished this by preparing wet handsheets in a Formette Dynamique handsheet former. The wet handsheets were wet pressed at 50 psi for five minutes to a solids content of approximately 32%. They were then cut into 5" x 0.625" strips using a Concora strip cutter. In order to determine uniformity, 10 strips were cut in alternating segments from a sheet containing 20 strips and bone dried. The weight of these averaged to 0.585 g, (sd=0.004 g), which translates to a percent standard deviation of only 0.7%. In subsequent handsheets, the averaged weight of four bone dried strips was used as the strip weight from that handsheet.

Dry Pulp

Market bleached softwood kraft pulp was used for the zero kappa experiments. Since this was a dry pulp, it was conditioned at 50% humidity and at 72°F in accordance with

TAPPI methods and the moisture content then accurately determined. Based on this moisture content, samples were carefully weighed out to the desired bone dry weight.

Gravimetry in Britt Jars

Test strips from the Formette Dynamique were soaked for 30 seconds and then agitated at 300 rpm in a Britt jar. The agitator was situated just above the 200 mesh screen. The model stickie used in this work was poyvinyl acetate (PVAc) which was prepared in methanol. The surfactant involved was Lionsurf 727, a non-ionic surfactant, used in deinking as a flotation aid. After the agitator was turned on, the surfactant (if used) was first added and then the PVAc (in methanol) was slowly introduced with a syringe. The system was maintained for 15 minutes with continuous agitation, after which the water was drained and collected. The volume of water was measured, and an aliquot was dried overnight. The fiber solids retained on the 200 mesh screen were also carefully collected and dried overnight. The results were interpreted as follows.

	solids in		**solids out**	
	fiber	**PVAc**	**fiber**	**water**
sample:	w_1	w_2	w_3	w_4
blank:	w_1	0	w_5	w_6

PVAc on fiber: $(w_3 - w_5)$; PVAc in water: $(w_4 - w_6)$

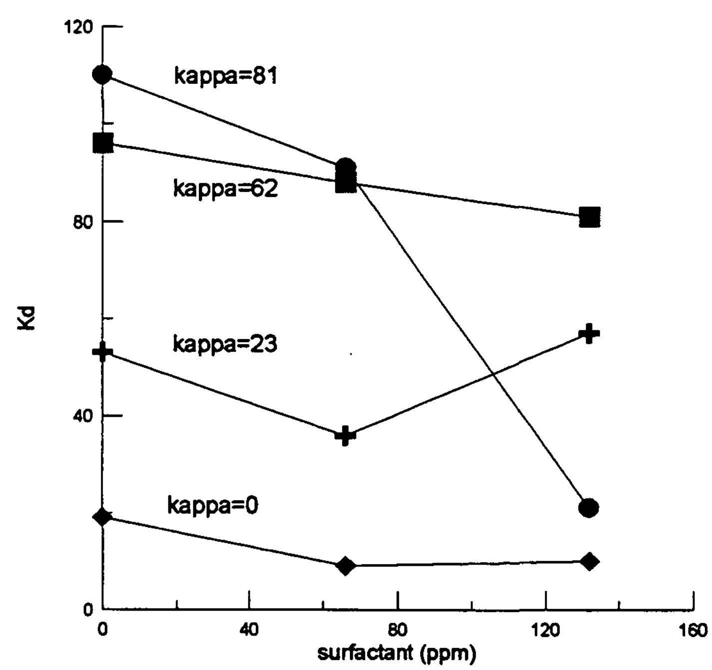
$$K_d = \text{conc. in fiber/conc. in water} = (w_3 - w_5)/(w_4 - w_6)$$

K_d is the fiber:water distribution coefficient. The higher the K_d, the greater propensity of the stickie to attach to the fiber. A typical result for a system comprising PVAc, kappa 23 pulp, and water is as follows. Each measurement was made in pairs, one with the PVAc (first

	solids in (g)			solids out (g)		
	fiber wt	PVAc wt	total wt	PVAc wt (fiber)	PVAc wt (water)	total wt
	1.7416	0.1	1.8416	1.7088	0.1062	1.8150
	1.7416	0	1.7416	1.6898	0.0365	1.7263
PVAc	wt. diff.	0.1		0.019	0.0697	0.0887

entry in the Table) and one without (second entry). The difference in weight in the "solids out" columns, i.e., 0.019 g. for the fiber and 0.0697 for the water, provides the PVAc attached to the fiber and that in the water respectively. This leads to a K_d value of 48.4 after adjusting for the mass of fiber (1.7416 g) and the volume of water present.

Similar K_d measurements made with softwood Kraft furnish and various levels of surfactant are illustrated below.



It is immediately clear that K_d is linear with kappa number, i.e., brown pulp attracts PVAc to a much greater degree than does bleached pulp. This occurs because the stickie is hydrophobic, and since the lignin in the pulp is also hydrophobic, the stickie preferentially associated with the lignin. The effect of surfactant is more difficult to decipher. Except for the kappa 81 pulp, the surfactant has a minor effect on K_d. The reasons for the steep decrease in K_d for the kappa 81 pulp are unknown. The decrease appears to be real because the result was questioned and the experiment repeated. The same results were obtained.

Stability of Stickies on Fiber

In order to determine the strength of the stickie-fiber attraction, bleached softwood kraft pulp was saturated with 19% by weight of PVAc homopolymer applied from a methanol solution. The treated pulp was then dried at room temperature, blended in different ratios with untreated pulp, and processed through the Britt jar. The results are as follows.

Percent treated pulp	PVAc in solids (g)	PVAc in water (g)	Solids in water/solids on Britt jar screen
0	0	0.00	0.02
50	0.2	0.038	0.03
80	0.4	0.01	0.02
100	0.64	0.035	0.02

Note that the amount of PVAc in water does not change appreciably as the blends change, suggesting that the PVAc in the pulp does not readily transfer to water under our experimental conditions. This is further confirmed by the solids ratio column. Although the amount of fiber and PVAc increases in both water and fiber phases as the amount of PVAc increases, the ratio does not. This indicates that the distribution of PVAc between water and fiber is constant because the PVAc is stuck to the fiber.

Attachment of Stickies to Fines

In order to further explore the effect of stickies on sorption, bleached pulp was beaten to different freenesses, and Britt jar sorption measurements were made with PVAc. The results are as follows. Note that K_d increases dramatically with decreasing freeness. The reason

Freeness	K_d	PVAc in water/fines in water
641	42	0.0041
575	127	0.0070
441	90	0.0066
335	539	0.0057
200	708	0.0061

for this is that the fines are better filtered in the low-freeness sheets, and the amount of material transferred to the water layer is greatly diminished. The last column in the Table expresses the PVAc:fines ratio in the aqueous phase. The values tend to be much more constant in this column, strongly indicating that the stickies present in the water are associated with fines, at least in the absence of surfactants and other chemicals.

Effect of Retention Systems

Since stickies seem to partition preferentially into the fines, it seemed likely that addition of a retention aid would dramatically increase K_d by reducing the fines content of the system. The retention system used was anionic colloidal silica (0.06 g); cationic starch (0.06 g); alum (0.03 g.); fiber (3 g.); resin (0.15 g); water (600 mL). Three types of PVAc were used

resin: 2873 flexible cross-linking PVAc latex for PSA (T_g=-36)
without starch: K_d=62
with starch: K_d=1,630 (355-3400)

resin: 1105 rigid PVAc latex for paper coating (T_g=29)
without starch: K_d=66
with starch: K_d=690 (235-1060)

resin: 9003-20-7 PVAc homopolymer, (T_g=29) in methanol
without starch: K_d=33
with starch: K_d=380 (210-480)

As expected, addition of cationic starch dramatically increases K_d, confirming the preferential adsorption of PVAc to fines.

Conclusions

1. The presence of fiber tends to retard PVAc agglomeration.

2. Retention aids increase K_d dramatically.

3. K_d is linear with kappa no.

4. Once attached to fiber, PVAc is not easily removed.

5. PVAc preferentially sorbs to fines.

Review of the Stickies Literature (1990-July 1994)

Method of Pacifying Stickies in Paper

Shawki, S. M.; Van Oss, R.N., Nalco Chemical Co.

U.S. Pat. 4,923,566, May 1990.

Typical stickies are non-hardening glues, such as those used on packaging tapes, on price labels, masking tape, office or other stationery, adhesive or any other application where quick tacking properties are required. In boxboard, the presence of stickies may cause two problems:

1) some of the stickies from the backliner may transfer to the topliner or coated topliner, and cause a visible blemish on the surface to be printed.

2) particles from the topliner, or the clay coating the topliner, may be transferred to the backliner during the unwinding of the paper rolls because they stick to the tacky surface of the stickies present on the backliner.

Urea in this patent is used to coat the surface of the stickies and "pacify" them. The urea is added as an aqueous solution to the water or starch box.

Reduction of Stickies Contamination in Papermaking Process Using Recycled Paper

Ling, T.-F., Betz PaperChem Inc.,

U.S. Pat. 5,139,616, August 1992.

The addition of specific blends of surfactants and solvents at 1 to 200 ppm to the pulper reduces the amount of stickies liberated from the furnish into the slurry by a factor of 5-10. The surfactant is a fatty alkanolamide or an ethoxylated compound; the solvent is a terpene or an aliphatic compound.

Organophilic Smectite for Sticky Pacification,

Ohtani, Y.; Sakamoto, K.; Wakai, M., Japan Pulp & Paper Research Institute, **Proc. Pan-Pacific Pulp Pap Technol. Conf. (Tokyo), Part A: 105-110 (Sept. 8-10, 1992)**

Stickies collected from three newsprint and one linerboard mill were mixtures of isoprene polymer which originates from pressure sensitive adhesive, and ethylene-vinyl acetate copolymer which comes from hot-melts. The ratios of the two stickies change with the sampling location in the mill, with the isoprene predominating in the screen and cleaner rejects and the dryer and calender deposits being enriched in the hot-melt stickies. A combination of organophilic smectite and cationic surfactant added to the whitewater system pacifies the stickies.

Experience and Proposal to Improve Sticky Problems in Deinking Plant and in Recycling Paper Processing for Paperboard, Kanazawa, T., Aikawa Iron Works Co. Ltd.,
Proc. Pan-Pacific Pulp Pap Technol. Conf. (Tokyo), Part A: 111-120 (Sept. 8-10, 1992)

Review of stickies removal efficiency as a function of equipment type and operating conditions. The stickies problem increases with increasing temperature and pH due to shredding. Also, increasing temperature softens the stickie and promotes its passage through screens.

Recyclable Pressure-Sensitive Adhesives
Scholz, W. F., Avery Dennison
Pulping Conf. (Atlanta) Proc. (book 2): 501-506 (TAPPI; Nov. 1-3, 1993)

This paper demonstrates the recyclability of pressure sensitive adhesives used in labels. There are four potentiial options for making a recyclable PSA. Water soluble adhesives would be recyclable, but product quality would suffer, and they would accumulate in the mill process water. Non-deformable adhesives could be screened out, but PSAs are elastomeric. Separation by density is inapplicable, since PSAs have roughly the same density as water. The fourth option of using a dispersable PSA was demonstrated in both lab and mill trials. In the lab trials stock containing 4.4 weight percent stickie was successfully repulped. Complete adhesive dispersion (particle size: 10-70µ) was observed at 45C and at pH 7; A 0.75 weight percent furnish was used in the field. It was claimed that the pulp in the field trial was whiter than usual!

Environmentally Conscious Hot-Melt Adhesives

Kauffman, T. F., National Starch & Chemical Corp.

Recycling: TAPPI Press Resource Guide: 10-12 (TAPPI Press, 1993)

Hot melt adhesives based on a unique class of graft copolymers (based on acrylates or vinyl acetate) are dispersible, and are recommended for repulpability

Impact of Hot-Melt Adhesives on the Paper Recycling Process

Hayes, P. J.; Kauffman, T. F., Nacan Products Ltd.

Tappi J. 76, no. 11: 162-166 (Nov. 1993)

This paper provides a general discussion; no new data are provided.

Hydrocyclone Removal of Sticky Contaminants During Paper Recycling

Chamblee, W. J.; Greenwood, B. F., Kamyr Inc.

U.S. Pat. 5,131,980

Pulp is reslushed to 1-4% consistency and fed to a hydrocyclone. Air is sparged radially inwards into the hydrocyclone. Hydrophobic contaminants attach to the bubbles and form a froth which is removed.

Quantification, Control and Retention of Depositable Stickies

Doshi, M. R., Doshi & Associates Inc.

Prog. Pap. Recycling 2, no. 1: 45-48 (Nov. 1992)

Four methods available for the quantification of depositable stickies and for the evaluation of additives are the polyethylene bottle method, low density polyethylene (LDPE) film method, polypropylene foam method and the polyester wire method. All are based on an increase in weight caused by the stickies.

Problem Solving Using Specialty Chemicals for Recycled-Fiber Processing

Allison, P. J., Buckman Laboratories SA

Pap. S. Afr. 12, no. 5: 47-48, 50,52 (Oct. 1992)

One approach towards stickie pacification is through a proprietary organic compound with a hydrophobic and hydrophilic moiety on a long chain fatty acid backbone. The compound disperses and detackifies stickies through micellar solubilization. Alternatively, a low molecular weight polymer with a high cationic charge density can be used to passivate and fix finely dispersed stickies to the fiber. This approach is employed in recycled fiber plants with a high degree of closure.

Surface Chemistry of Flotation of Stickies and Laser-Printed Inks

Stratton, R. A., IPST

J. Pulp Pap. Sci. 18, no. 6: J221-224 (Nov. 1992)

Removal of stickies (hot melts) and laser-printed inks from recycled paper is facilitated by froth flotation. The efficiency of the process is a function of the surface tension of the deinking liquor and the surface energy of the contaminants. The latter increases on contact with the deinking liquor on a time scale of seconds to minutes, possibly reflecting a reorientation of the surfactant on the surface of the stickie.

Behavior of Waste-Paper Stickies in Recycling Mills

Crawford, D.S., Amcor Research & Technology Center

Appita 46th Annual Gen. Conf. (Australia) Proc.: 409-415 (1992)

Appita J. 45, no. 4: 257-259 (July 1992)

Bauer-McNett fiber classification of recycle furnish followed by dichloromethane extraction showed that stickies were concentrated in the fines fraction as shown overleaf.

Stock Fraction (Tyler mesh)	Percent of total sample	fines percent	ash percent	extracts percent
+20	26.3	3.76	0.81	0.26
-20 to + 35	18.5	2.68	0.62	0.14
-35 to +100	24.4	3.48	0.74	0.22
-100 to + 150	4.0	17.17	3.48	0.81
-150	26.8	59.02	27.02	4.93

The stickies were mainly EVA hot-melts. This finding contrasts with earlier work that considered the oversize of 0.15 mm slotted screens where stickies were presumed to be associated with long fibers. It is suggested that management of filtrate from dewatering units and the backwater could alleviate the stickies problem.

New Research into Stickies Removal

Cathie, K., Pira International

World Pulp Pap. Technol. 1992: 57-58, 60-61 (1992)

General review article with no data. The article suggests that minimization of the stickie problem should be examined by modifying some combination of mechanical methods, chemical methods, and the structure of the stickie and the adhesive.

Pressure Sensitive Adhesives which Are Compatible with Paper Recycling Process

Wu, M. S. S., 3M Co.

Pulping Conf. (Boston) Proc. (book 2): 451-452 (TAPPI; Nov. 1-5, 1992)

This paper discusses properties of pressure-sensitive adhesives from the recyclability perspective. Water soluble/dispersable adhesives have been advocated by the industry as being the most desirable of the PSAs. However, this is difficult to achieve from the product quality standpoint since tape performance will be adversely affected under humid conditions. Also, the soluble chemicals will accumulate in water recirculation loops, which will require treatment.

Polyacrylates copolymerized with other hydrophilic monomers (acrylic acid) is a typical water soluble PSA. Water insoluble PSAs are currently viewed as the major stickie problem. However, if the adhesive can be designed to have high mechanical strength they will not fragment and be screened out. It is claimed that a PSA prepared from synthetic poly(styrene-b-isoprene) with a tackifying resin meets the requirements of high internal strength, hydrophobicity, low affinity to paper, tackiness in aqueous media, non-conformability and non-compressibility.

Cost-Effective, Common-Sense Approach to Stickies Control

Fogarty, T. J. , Betz PaperChem

Pulping Conf. (Boston) Proc. (Book 2): 429-438 (TAPPI; Nov. 1-5, 1992)

Chemical technologies for stickies control can be divided into five sub-categories.

Dispersion: Chemicals added to the repulper serve to break down particle size and to prevent reagglomeration. Chemical mechanisms involve wetting, emulsification, solubilization, and stabilization.

Detackification: These chemical stabilize and detackify stickies particles but do not reduce their physical size. Nonionic polymer, zirconium, and talc are three detackification treatment strategies. Nonionic polymers encapsulates the stickie particle and increase their hydrophilicity. Organic salts of zirconium have been used with limited commercial success. Talc has both hydrophobic and hydrophilic properties. The hydrophobic surface of talc attaches to the stickie and reduces its tackiness. A drawback with talc is that is shear-sensitive.

Cationic polymer: These are of low molecular weight and of high charge density, and fix a stickie particle to a fiber which are both anionic. They are typically added at the machine chest, and serve as a retention aid.

Passivation: Low molecular weight high charge density polymers are applied to the wire to create a soluble barrier which keeps the treated aréa free of stickies. Forming fabric and roll neutralization occurs when passivation products stabilize contact surfaces.

Cleaning solvents: These are used to clean machine fabrics. They should not be returned to the process since they can enhance interaction between stickies. Also, environmental release of solvents is a concern.

Three case histories are discussed. Treatment of stock (office waste or OCC) with nonionic polymeric detackifiers and wire passivation reduced downtime in a tissue and a corrugated mill. Use of excess cationic polymer in a recycle mill failed to alleviate a stickies problem. However, pulper dispersion chemistry coupled with detackification technology substantially improved downtime.

Use of Talc to Control Stickies in Deinked Newsprint

Holton, J. E.; Cavanagh, W. A.; Williams, G. R., Cyprus Industrial Minerals

Contaminant Problems & Strategies in Waste Paper Recycling Sem. (Cincinnati, OH) Notes: 157-159 (TAPPI 28-30, 1992)

General paper on the benefits of using talc with ONP/OMG stock.

Understanding the Fundamental Factors Influencing Stickies Formation and Deposition

Cathie, K.; Haydock R.; Dias, I., Pira International

Contaminant Problems & Strategies in Waste Paper Recycling Sem. (Cincinnati, OH) Notes: 149-156 (TAPPI 28-30, 1992)

A test furnish containing equal amounts of hardwood and softwood bleached Kraft pulp with added acrylate polymer from labels was treated under various conditions. Pulping under alkaline conditions as opposed to either neutral or acidic conditions produced a greater number of stickies of smaller size and greater tackiness. Increasing water hardness to 30 ppm by adding calcium chloride to the stock suspension decreased stickie deposition by 70%. It was hypothesized that the Ca^{++} neutralized the anionic stickies and induced their agglomerization.

Tissue mills have noted that a sudden build-up of stickies occurs on paper machine forming fabrics after the use of propietary cleaners. This raises the possibility that the cleaners encourage stickie deposition. To test this, a paraffin solvent based cleaner was added directly to the stock and was found to substantially increase stickie formation.

The Effect of System Charge on Stickies Deposition

Sigman, M.A.; Röhlf, E.V., GRACE Dearborn

TAPPI Pulping Conference, 1993, 507-518

Optimum runnability is obtained when the colloidal soluble surface charge is maintained anionic and within a defined range. The charge is controlled through addition of anionic or cationic charge control additives.

Increasing the use of secondary fiber: an Overview of Deinking Chemistry and Stickies Control

Olson, C. R.; Letscher, M. K., Betz PaperChem Inc.

Appita J. 45, no. 2: 125-130 (March 1992)

Stickies are classified into three general categories: hot melts, PSAs, and waxes. Hot melts usually consist of a polymer backbone (ethyl vinyl- or polyvinyl acetate) and a tackifying resin. These low cost adhesives are used in applications such as bags, boxes cups, tubes, envelopes, and book/magazine bindings. Tackiness increases with temperature. PSA tackiness is not temperature sensitive. The major components include a polymer such as SBR and a tackifying agent. PSAs enter the system through packing tape, mailing labels, transfers, and self-sealing envelopes. Waxes come from coatings on paper and paperboard. Waxes can transition from solid to liquid depending on the transition temperature. Waxes cause blooming in the dryer section where small wax particles melt and spread into large greasy spots. Upon cooling, these adhere to adjacent sheets and cause picking. This paper emphasizes a total stickies control strategy, as opposed to transferring the problem from one part of the system to another.

Removal and Control of Stickies

McKinney, R. W. J., Pira, UK

EUCEPA Symp. Recycling Fibers & Fillers in Pulp & Paper Ind. Proc., Vol. 1: 159-174 (Oct. 23-27, 1989)

General review of the stickies problem.

Control of Stickies by Chemical Methods

Bennett, C., Betz Europe Inc.

EUCEPA Symp. Recycling Fibers & Fillers in Pulp & Paper Ind. Proc., Vol. 1: 175-185 (Oct. 23-27, 1989)

Typical stickies are SBR (from contact adhesives, xerographics, and coating latex), polyvinyl acetate (from coating binder), polyisoprene (from contact adhesives), ethylene vinyl acetate (from hot melts), phthalate esters (from hot melts), and styrene ester coploymers (from contact adhesives). Factors that influences agglomeration and deposition of stickies are as follows:

<u>liquid factors</u>

conductivity, pH and pH change, temperature , presence of solvents, and excess Al^{3+} ions.

<u>particle surface factors</u>

chemical structure, surface charge, surface viscosity, temperature, co-deposition

<u>collision rate</u>

concentration, turbulence, temperature, shear, charge

<u>particle agglomeration</u>

surface chemistry, co-deposition, surface temperature, surface charge

Recycle Fibre- Control of Stickies

Chapman, S., Grace Australia Ltd.

Appita 45th Annual Gen. Conf. (Australia) Proc., Vol. 2: 103-107 (May 2-3, 1991)

Wire and felt treatment with a spray of a proprietary chemical leads to the formation of a protective film that prevents the adherence of pitch and stickies.

The Flotation of Sticky Contaminants from Recycled Fiber Streams

Stratton, R. A., IPST

IPST Tech. Pap. Ser. no. 398: 22 P. (Sept. 1991)

The Girifalco-Good-Fowkes-Young (G-G-F-Y) equation for surface energy was found to apply to four stickies: wax and hot-melts based on polyvinyl acetate/polystyrene paraffin, glycerol ester of polymerized rosin, and polyethylene in the presence of surfactants. This enables a surfactant to be chosen on the basis of its surface tension so as to be compatible with the surface energy of the stickie.

Stickies Control by Detackification

Moreland, R. D., Betz PaperChem, Inc.

Recycling Paper, Vol. 2: 508-511 (1990; TAPPI Press)

Regardless of the chemical composition of stickies, it is the property of contact adhesion that causes the stickies to interfere with the runnability of a paper machine. The problems that a particular species may cause will depend on its origin. For example, the problems caused by wastepaper containing a styrene butadiene (SB) latex based coating will be entirely different from a wastepaper containing a few SB contact adhesive labels.

Stickies are classified as follows: contact adhesives (SBR, vinyl acrylates, polyisoprene, polybutadiene, natural rubber) and hot melts (EVA, PE, wax, tackifying resins). A peel test was used where an adhesive-backed tape and a polyethylene coupon was exposed to various treatment solutions and then pressed together. Peel strength was then measured with an Instron tensile tester. Numerous surfactants and dispersants were tested. Ethoxylated nonyl- and dodecylphenols combined with ethylene oxide were effective; surprisingly, octylphenol was not. The hydrophobic lipophobic balance did not correlate with the detackification effect. The utility of ethoxylated nonylphenol was reduced by excessive foaming. Two proprietary chemicals were claimed to perform much better.

Repulpable Pressure Sensitive Adhesives Designed for Paper Recycling

Chou, C.S., Rohm & Haas Co.

1993 TAPPI Recycling Symposium, pp.389-404

There are three schools of thought on what constitutes a repulpable adhesive.

1. A separable/screenable adhesive must be physically rigid. However, most PSAs are soft, and this approach is considered impractical.
2. Water soluble adhesives would become invisible after the pulping process. However, adhesive build-up would occur in the water system and would eventually cause problems.

3. Redispersable adhesives disperse into small particles during pulping. The particles are not water soluble, and leave the system with the product. Desirable characteristics are the ability to disperse to suspended particles of less than 70μ and not to further aggregate, and to retain particle size so as to be removable by deinking/floating if applied. A proprietary emulsion was claimed to have these properties.

Chemical Treatment Program for Stickies Control

Miller, P. C.

Betz PaperChem

Recycling Paper, Vol. 2: 471-474 (1990; TAPPI Press)

Two approaches are advocated: dispersion and detackification. In one case study, a dispersant was added at 3 lbs/ton to the pulper and another at 3 lbs/ton at the refiner. The second addition was to prevent re-agglomeration of stickies liberated on refining. A downtime reduction of 70% was claimed. For detackification, a proprietary compound was developed.

Aluminum Control Prevents Stickies Problems

Ormerod, D. L.; Hipolit, K. J., Calgon Corp.

Recycling Paper, Vol. 2: 489-495 (1990; TAPPI Press)

Overuse of alum is common in mills, and the excess aluminum magnifies the stickies problem by promoting coagulation. Aluminum sequestration is proposed where an unspecified sequestrant is added to tie up the excess aluminum in a loose complex. When the aluminum demand increases (eg. due to the presence of stickies) the complexed aluminum is released. Thus, the sequestrant serves to buffer the aluminum.

Developments in the Control of Stickies

Hoekstra, P. M. and May, O. W., Buckman Laboratories, Inc.

Recycling Paper, Vol. 2: 446-454 (1990; TAPPI Press)

This paper discusses the stickie problem and promotes the use of dispersants. Some examples are as follows. Polyvinyl acetate was a problem in a mill using 15-20% OCC. Addition of a dispersant at 3 lbs/ton greatly reduced the problem. Polyvinyl acetate deposits in another mill using 100% deinked newsprint were prevented by applying a dispersant at 0.3 lbs/ton to the Uhle box lubricating showers. Another mill attempted to use synthetic fibers in the repulper to capture stickies. A dispersant added at 12-15 lbs/ton reduced deposits at much lower cost. Transfer of deposits from backliner to topliner on the reel decreased quality in one mill. Addition of a mixture of nonionic surfactants and nonionic and anionic dispersants to the repulpers and to the thickened stock just before the paper machine solved the problem.

Dispersants can have the following detrimental effects. Dispersant addition to a system contaminated with a large amount of stickies can break these deposits loose. In this case an alkaline boil-out is recommended. The dispersant can have a major detrimental effect on sizing by preventing size from depositing on the fiber surface. Hence, stickies problem with sized grades of paper are particularly difficult.

Test methods for assessing stickie contamination are reviewed. The basis for these are stickies counts and tackiness. Problems are encountered with stickies counting with samples containing high debris or flake content. Also the stickie size can be altered by the screening used to separate out the stickies. Temperature may also play a role, especially for hot melts. Problems with stickies estimation by solvent extraction are that some stickies may not dissolve in the solvent used, and that varying amounts of non-stickie material can be extracted. A tack test where stock containing stickies is cycled through a fabric is the most realistic since it simulates a paper machine situation. However, no-stickie particles such as ink debris can be trapped in the fabric and be counted as stickies. Tack tests which measure the bond between a tape coated with stickies and a polyester film are considered to be less relevant since soft tacky stickies have low bond strength, and the effect of residual chemicals such as rosin in the mill system are not considered.

A Review of Stickie Control Methods Including the Role of Surface Phenomena in Control

McKinney, R. W. J., Pira

Recycling Paper, Vol. 2: 439-445 (1990; TAPPI Press)

This paper makes the observation that while removal processes rely on differences in properties between stickie and fiber, few use the characteristics in which stickies and fibers are very different, namely in surface energy and surface charge. The paper review methods of stickie removal and classifies them into mechanical and chemical methods. It suggests that a model wastepaper plant should include high consistency pulping, high consistency fine screening, low consistency centrifugal cleaning with both forward and reverse flow cleaners, fine screening, possibly following a significant pH change, no vibrating screens as final treatment of reject flows, a dispersion plant, and on-machine systems such as showers and cleaning brushes.

The efficiency of centrifugal cleaners were considered to be overstated. For example, while efficiencies of up to 60% were obtained by single stages, the overall system efficiency was 10-40%. Slotted screens were found to be the single best method for removing stickies. Dispersion was also found to be effective as was chemical treatment through the addition of agents for dispersion, passivation, spray treatment, solids retention or enhanced removal.

A Rapid Method for Qualitative Analysis of Stick by Pyrolysis-gas Chromatography

Dunlop N. J.; Allen L.H., Paprican

Recycling Paper, Vol. 2: 463-467 (1990; TAPPI Press)

Pyrolysis-gas chromatography can be used to characterize stickies such as styrene-butadiene which have a well-defined program. Its utility when confronted with complex residues is less certain.

Image Analysis for Measuring Adhesive Contaminant in Pulp

Klungness J. H.; Fernandez L. P.; Plantinga P. L.

USDA Forest Service, Forest Product Laboratory

Recycling Paper, Vol. 2: 455-461 (1990; TAPPI Press)

Image analysis (IA) is able to detect and report the size distribution of contaminants such as hot melt adhesives in recycled pulp. However, the technique overstates the amount of material present in the pulp since it assumes that the contaminant is distributed evenly throughout the pulp which is usually not the case.

Interaction of Cationic Latex with Pulp Fibers

Alince, B.

No 3. 1985 Paperi Ja Puu (p118-120)

Deposition of a styrene butadiene latex to pulp is not linear with concentration. In other words, proportionately less latex is deposited with increasing latex concentration. This is attributed to the presence of soluble cationic species that compete with the latex for anionic sites on the pulp.

Test Methods for Assessing Stickie Contamination - a Review

1987 Pulping Conference / TAPPI Proceedings (p725-728)

The advantages and drawbacks of four test methods (peel, solvent extraction, tack, and inspection) to assess stickie contamination are discussed.

Physical Chemistry of the Absorption of Talc, Clay and other Additives on the Surface of Sticky Contaminants

Williams, G. R., Cyprus Industrial Minerals Company

1987 Pulping Conference (563-570)

Minerals such as talc and calcium carbonate are either added to control stickies or enter the system with the stock. These materials interact with stickies and can enhance or minimize the stickies problem. Calcium carbonate and clay reduce the tackiness of a stickie but increases its volume. Depending on its location in the system, these materials can create more problem than they reduce. Talc is the most useful mineral that is presently used. Owing to its structure (a magnesium sheet sandwiched between two silica sheets) talc has a hydrophobic surface with a hydrophilic edge. This allows it to collect and detackify hydrophobic stickie particles and then incorporate itself with the stickie into the sheet.

A Survey of the Various Contaminants Present in Recycled Wastepaper Whitewater Systems

Scott, W.E., Miami University

TAPPI Contaminant Problems & Strategies in Waste Paper Recycling Seminar (Madison, WI), Notes: 3-6, April 24-26, 1989

Close-up of the whitewater system in order to decrease environmental impact leads to an increase in contaminants in the white water system. These may include relatively insoluble materials such as resin acids or adhesives and hot melts, mineral pigments such as clay or titanium dioxide, and dissolved salts. The properties of these materials and their compatibility with various mechanical and chemical cleaning operations are reviewed.

Methods for the Detection of Stickies in Pulp

Forester, W., Wester Michigan University

Deinking Short Course (Indianapolis) Notes: 14 p. Tappi, June 13-15, 1993

Review of methods such as the Berol method, Sulzer Escher Wyss method, fluorescent counting.

Controlling Stickies with Water-Soluble Polymers

Dykstra, G.M., May, O.W., Buckman Labs.

Recycling Paper, Vol. 2: 527-530 (1990; TAPPI Press)

The use of water soluble polymers is proposed for fixing small particles to fiber. Also, if the anionic charge builds up in the wet end loop, the less water soluble materials will deposit. The anions can be charge neutralized with the addition of cationic polymers. Cationic polymers can be used for stickies fixation. These are often of low molecular weight and of high charge density. Anionic polymers are commonly used as dispersants, but it is possible to design in charge and molecular weight characteristics to make them aid the cationic polymer in fixation. High molecular weight fillers and fines are used to retain fillers and fines that have small stickies fixed on their surfaces. In order to avoid problems it is strongly recommended that trials be run (especially with multiple polymer additions) to ensure that polymer-stickie compatibility.

New Technology for Stickies/Pitch Control with Increased Production/Profitability

Kenney, R.M., Engstrom, G.G., W.R.Grace & Co.

TAPPI Pulping Conference, Proc. (Book 2): 339-343

The wire is treated through fresh water showers with a cationic polymer that forms a combined cationic/anionic film on the wire. The anionic component comes from anionic trash. A typical treatment level is 5-15 mL/min of the chemical per meter of wire. The system is claimed to work across a pH range of 4.2-11.5.

Additives to Combat Sticky Contaminants in Secondary Fibers

Doshi, M.R.

TAPPI Contaminant Problems & Strategies in Waste Paper Recycling Sem. (Madison, WI) Notes: 81-89 (April 24-26, 1989)

Good concise general review examining the effect of talc, solvents/dispersants, synthetic fibers, zirconium compounds, and alum sequestering agents in alleviating stickie deposits.

Use of Zirconium Chemical in Sticky Contaminants Control

Goldberg, J.Q., Carlisle Chemical

Recycling Paper, Vol. 2: 496-507 (1990; TAPPI Press)

Several mill trials with zirconium compounds are described. On occasion, a dual application process is recommended. Here, the zirconium compound is added together with a chemical that selectively binds the zirconium-bonded complex to the sheet. This prevents stickie build-up in the whitewater. Laboratory adhesion measurements were made with several adhesives including a pressure sensitive acrylic, a hot melt containing ethylene vinyl acetate (EVA) copolymers, a pressure sensitive hot melt containing EVA, methyl styrene and a rosin derivative, and a pressure sensitive hot melt containing styrene-butadiene-styrene block copolymers and rosin esters. Zirconium compounds reduced the tackiness of all these adhesives, particularly that of the acrylic. It was less effective with the styrene polymer (presumably because this material doesn't have any suitable ligands for zirconium..SB). Overdosing with zirconium drastically reduced tackiness in all cases.

A New Approach to the Control of Stickies

Ward, J., Blandin Paper, Hensel, D., Patterson, J., Henkel Corp.

Tappi, 1994 Recycling Symposium

A highly charged low molecular weight cationic polymer is used to fix stickies to fiber. The polymer is particularly effective when used in conjunction with a low-foaming non-ionic surfactant dispersant.

Effect of Pulping Conditions on Stickies Behavior in Office Waste Deinking Systems

Ling, T.F., Sulman, F.J., Richman, S.K., Letscher, M.K., Betz PaperChem.

Tappi, 1994 Recycling Symposium

Pulping Office Waste Paper (OWP) showed that the majority of stickies (from adhesives and strapping tape) associated with ink particles from laser printing. Three pulping conditions were used: (I) 120F, ambient pH; (ii) 150F, pH=11; 150F, (iii) pH=11, 1% deinking chemical on dry fiber. Surprisingly, condition (ii) did not produce more smaller size particles than condition (I). Case (iii) increased the size of the aggregates, i.e. reduced the number of particles. It appears that aggregation occurs under the harsh conditions of case (iii). Case (iii) conditions also enhanced the forward cleaning efficiency.

Stickie Pacification with Synthetic Pulps

Wade, D.E., Hercules Inc.

Recycling Paper, Vol. 2: 536-541 (1990; TAPPI Press)

It is shown that synthetic polypropylene fibers scavenge stickies. However, a requirement is that the stickie be tacky at the operating temperature. Difficulty is experienced with "hard stickies" such as hot melts, waxes, and coating latexes that are non-tacky during pulping, but acquire tack during a subsequent process such as drying.

Semi-Annual Patent Review. January-June 1992

Schmitt, G.D., Doshi, M.R.

Progr. Paper Recycling, pp 49-54, November 1992

Two patents are outlined. Quaker Chemical (US patent 5080759) claims an organotitanium compound that detackifies stickies at 0.085-0.85 lbs/ton while in the pulp slurry. Hossain and Blaney (US patent 5009746) claims an application of supercritical carbon dioxide at 60-300 atmospheres and at 30-90C to reduce stickies.

Stickie Pacification-New Additive

McKinney, R.W.J., Currie, P.G.C., Pira

Recycling Paper, Vol. 2: 512-518 (1990; TAPPI Press)

The interaction of polypropylene fibers with stickies is studied in detail with electron microscopy. An interesting observation is that laboratory preparation of stickies does always lead to stickies with the same characteristics as those in a mill. For example, a laboratory polyisoprene preparation was hard and non-tacky and showed no affinity towards the synthetic fiber, whereas, mill polyisoprene stickies were soft and tacky and readily associated with the poplypropylene. Changes in pH had little effect on the sticky-fiber association.

Synopsis of the Stickies Literature

- Additives used to combat stickies include surfactants and solvents, additives with both hydrophobic and hydrophilic functionalities, talc, zirconium salts, neutral or cationic polymers, synthetic fibers, and organotitanium compounds. Supercritical carbon dioxide has also been used to extract stickies.
- Use of solvent cleaners encourages the build-up of stickies by increasing their tack.
- The contact adhesion property of a stickie is more important than its chemical structure. For example, a styrene butadiene latex behaves differently than a styrene butadiene contact label.
- Salts such as calcium and aluminum are claimed to mitigate the problem. However, overuse of aluminum can increase the problem.
- Water quality adhesives are not an option since product quality suffers (in humid environs) and build-up occurs in the whitewater loop. Dispersable adhesives or additives that cause dispersion seem to be the preferred approach.
- Stickies concentrate in the fines fraction. However, this is not established since an earlier study showed the opposite effect, i.e., stickies were associated with the long fraction.
- Stickies problems increase with increasing pH and temperature due to increased softening and shredding.